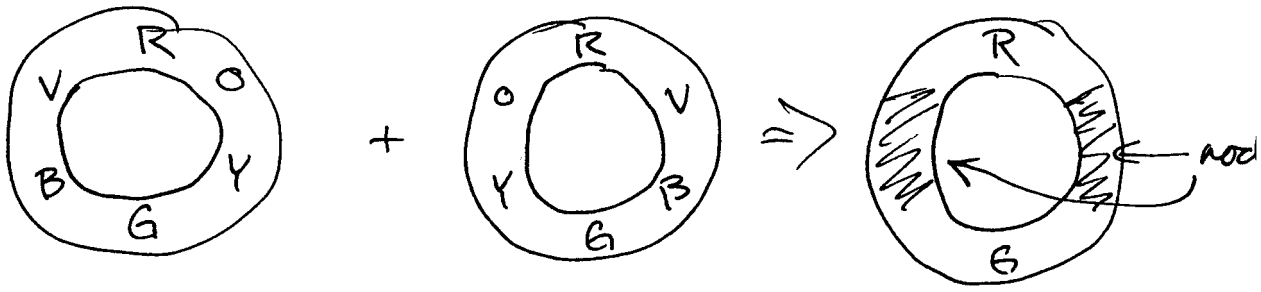
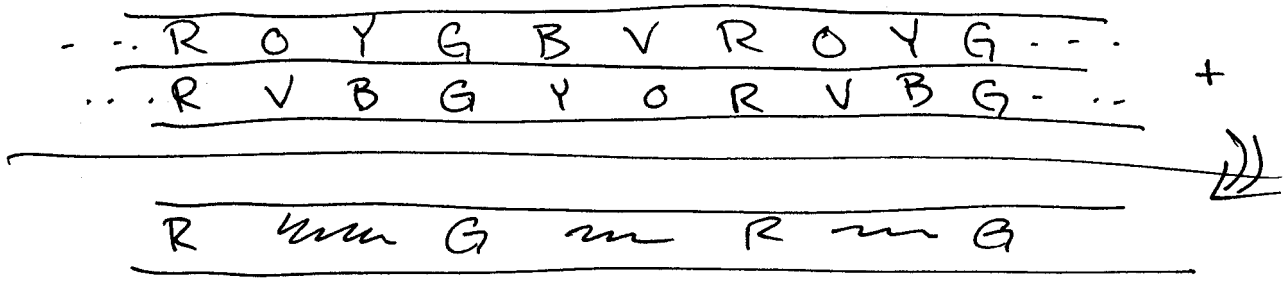
Physics 131 - Homework XII - Solutions

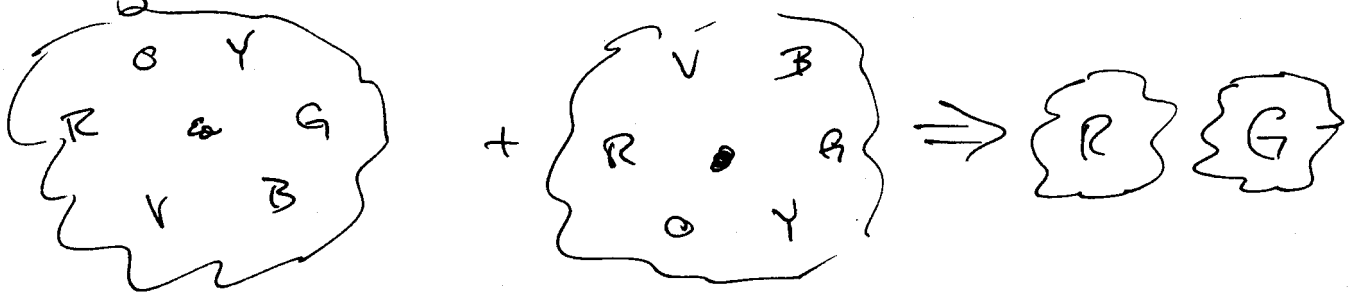
1.



This is like the standing wave we get superposing

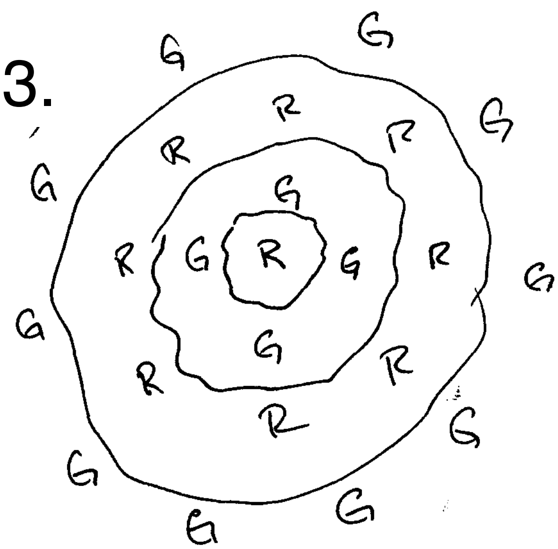


2. The result is just like above, except not confined to a hoop. So, instead of a bright patch on the hoop, we get bright blobs:



which looks very like $n_r=0$, $n_\theta=1$, $n_\phi=0$, only turned 90° sideways (in fact - it is exactly that!)

3.



This has 3 radial nodes, so $n_r = 3$.

This has no angular dependence,

So ~~$n_\theta = n_\phi = 0$~~.

$n_\theta = 0$ and

$n_\phi = 0$.

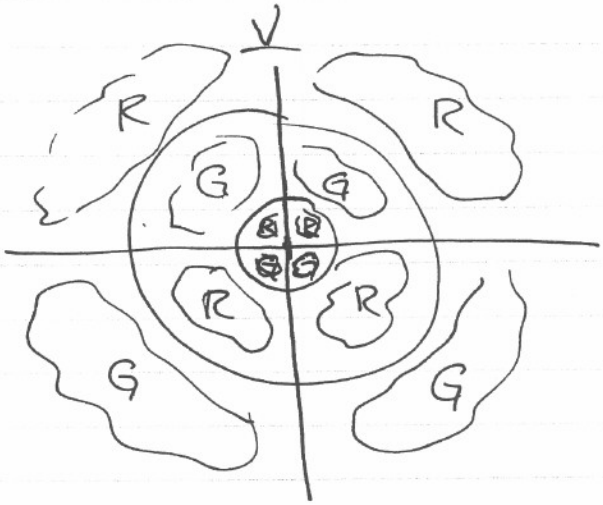
4. 2 radial nodes $\Rightarrow n_r = 2$
3 angular nodes $\Rightarrow \ell = 3$
2 ϕ nodes $\Rightarrow m_\ell = 2$ (or -2)

$$n = n_r + n_\theta + |n_\phi| + 1 = n_r + \ell + 1 = 6$$

$\ell = 3$
$m_\ell = 2$ (or -2)

$L^2 = \ell(\ell+1)\hbar^2 = 12\hbar^2$

5. First - draw nodal surfaces – 2 radial, • | $\ominus$
Then fill in colors on H cut to make 2 ϕ "nodes"
& alternate colors on V cut:



6. First - fill n=1 – 0 nodes – $n_r = 0, n_\theta = 0, n_\phi = 0$, 2 spins $\Rightarrow$ 2 electr
Next - fill n=2 – 1 node – $n_r = 1$, rest zero $\Rightarrow$ 2 electrons
$n_\theta = 1$, rest zero $\Rightarrow$ 2 electrons
$n_\phi = +1$, rest zero $\Rightarrow$ 2 electrons
$n_\phi = -1$, rest zero $\Rightarrow$ 2 electrons
} 8 more, for a total of 10
Next - fill n=3 – 2 nodes, but avoid ang nodes, so $n_r = 2$ for last electron
$n_\theta = n_\phi = 0$ or $n=3, \ell=0, m_\ell =$